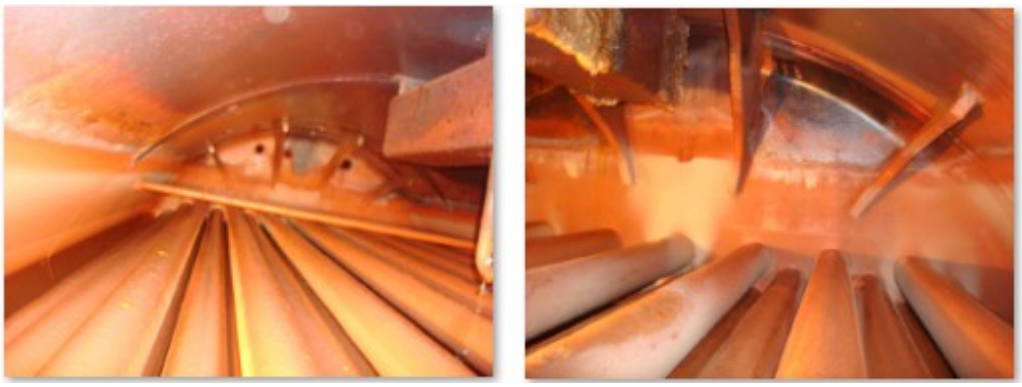
CHAPTER 22: REMOVAL OF BOILER TUBES FOR REPLACEMENT

When replacing tubes in fire-tube and water-tube boilers, one of the most delicate procedures is the extraction of the tubes mandrel-grooved and flanged to the plates or mandrel-grooved and welded to the plate.

This leads to various methods for cutting the tubes at the mandrels in order to remove the mandrel or welded tube sleeves without damaging the plate, since the tube seat on the plate hole must not be damaged under any circumstances.

This is because when the tubes are re-mandreld, this damage could cause a leak or the beginning of a crack in the plate.



FIRE TUBE BOILER: FRONT AND REAR PLATES AND TUBES

Remember that the tubes are not only mandreld or welded to maintain a watertight seal, but their function is also to support the internal pressure stress of the boiler on the plates.

The issue of expansion and contraction (which often exceeds the pressure stress) is also significant.

There are several methods for cutting the tube, then removing the tube sleeve that remains on the plate, and then making a longitudinal cut (to disassemble the mandrel tube sleeve and extract it), thus reducing its diameter by decreasing its expansion diameter.

The cut tubes are then extracted through a hand-operated cap on one of the plates. It could also be done without cutting the tube and instead making a longitudinal cut in the sleeve without separating it from the tube, then extracting it by applying force to one end, passing a sling or rod through the tube and pulling it with a heavy-duty jack (ratchet).

This method is very cumbersome because the tubes usually have some encrustation, which not only makes it difficult to pass through the hole in the plate, but can also damage the hole's seating surface due to the forced pulling of the tube.

When you see the methods that allow you to cut the pipe a few centimeters from the plate, it seems tempting to use a motorized internal pipe cutter (a tool that looks similar to a mandrel, but actually has an internal cutting tip that adjusts as you rotate the tool from the outside, as if it were a mandrel), usually motorized (air, electric, etc.) but there are also manual ones.

These methods seem tempting for cutting pipes, but they are very time-consuming, since the "cutting tool" must advance slowly to cut the pipe without expanding it.

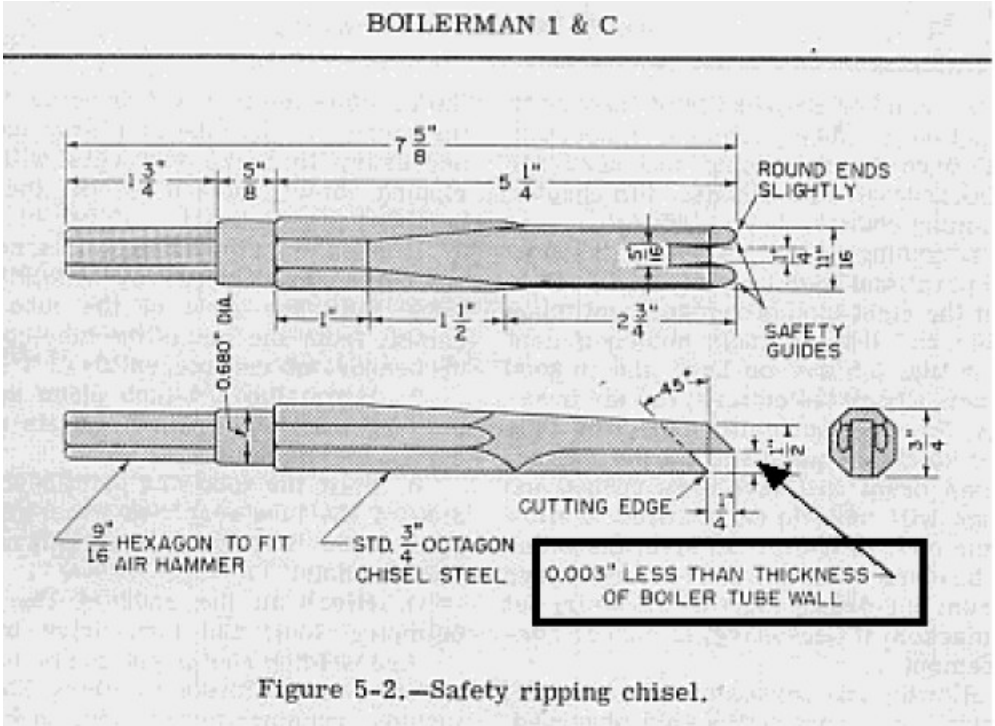
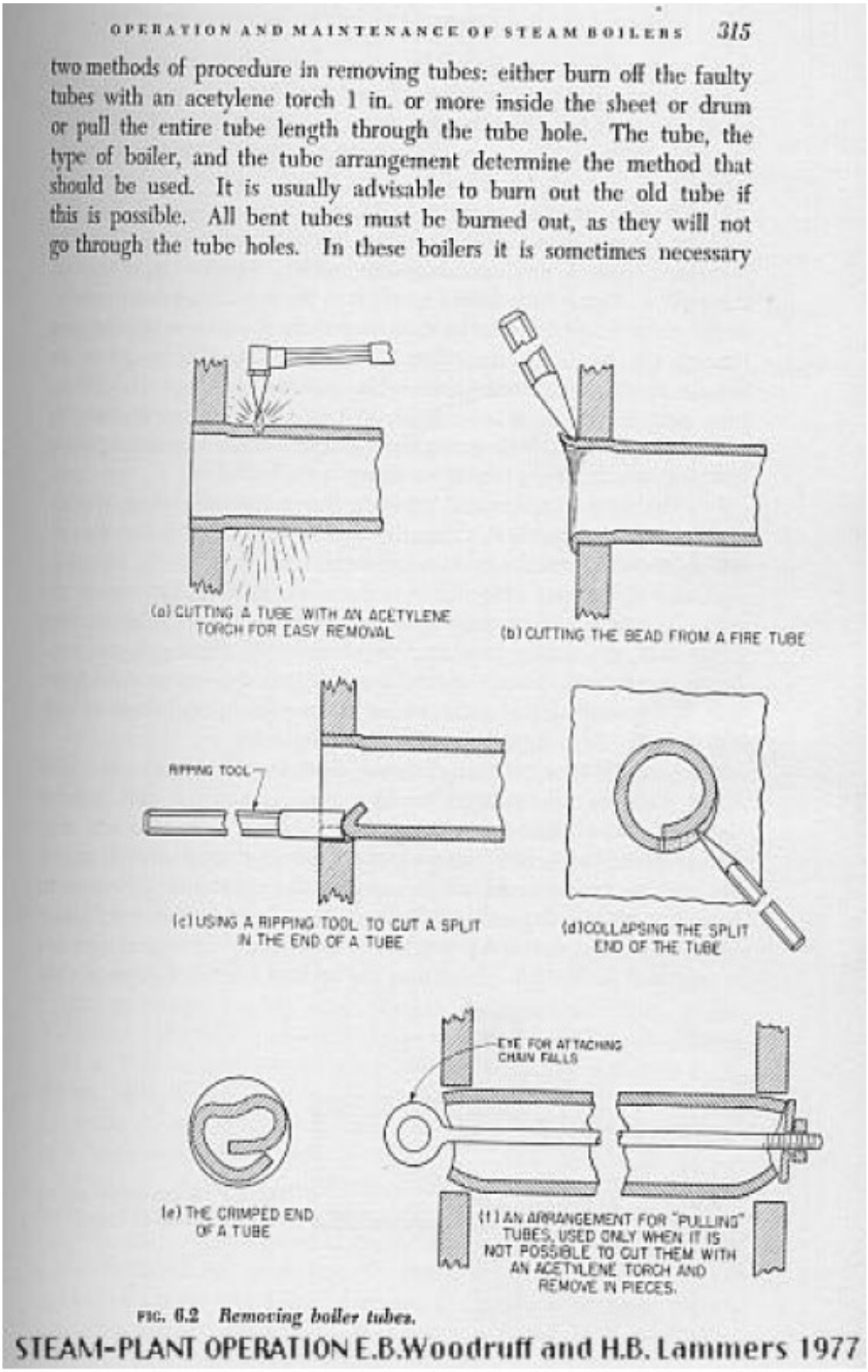


Figure 5-2.—Safety ripping chisel.

A well-trained torch operator can cut the pipes in a few minutes, and this operation does not damage the plate if done carefully, since the cut is made a few centimeters inside the pipe (usually 3 to 4 cm). Once the tubes are cut, they will exit through a cap in one of the plates, which is usually provided for this purpose.

The tube sleeve remains firmly attached to the plate; this is where the operation is most delicate, as the longitudinal cut of the sleeve must not damage the plate. A pneumatic or manual percussion tool can be used for this task.

Figure 5-2 (from the book BOILERMAN 1&C) shows the dimensions of one type of these tools.



The user should not assume that this eliminates the risk of scratching the pipe seat in the plate; it is a very dangerous operation if performed by a worker without the necessary knowledge and experience.

Producing a tool with sufficient hardness is not easy, since generally, the harder the tool, the more brittle it is, and the cutting tip tends to break.

Anyone who has retubed boilers with more than 200 mandrel tubes in the headers of sectional boilers knows that this method of longitudinal cutting (in relatively thick-walled tubes, e.g., 4.5 mm wall thickness), with the headers supported by the water and steam riser and downpipes themselves,

can lead to continuous "knocking" and loosening of the mandrel seats of the tubes that will not be replaced or that have already been replaced to hold the headers in place (including the seats on the upper and lower domes).

Although it may seem risky, I've seen torch operators making longitudinal cuts with a torch without damaging the plate seats (using bottled gas, not oxyacetylene).

MANUAL TUBE CUTTER

This is debatable, but often, in reality, it seems that the best isn't necessarily the best, and we have to accept realities that the books don't cover.

Now, if by using a torch operator who lacks the skill to cut the longitudinal sleeves quickly and without cutting to the depth required to mark the plates (or using an oxyacetylene torch), we're causing very costly damage to the plate seats.

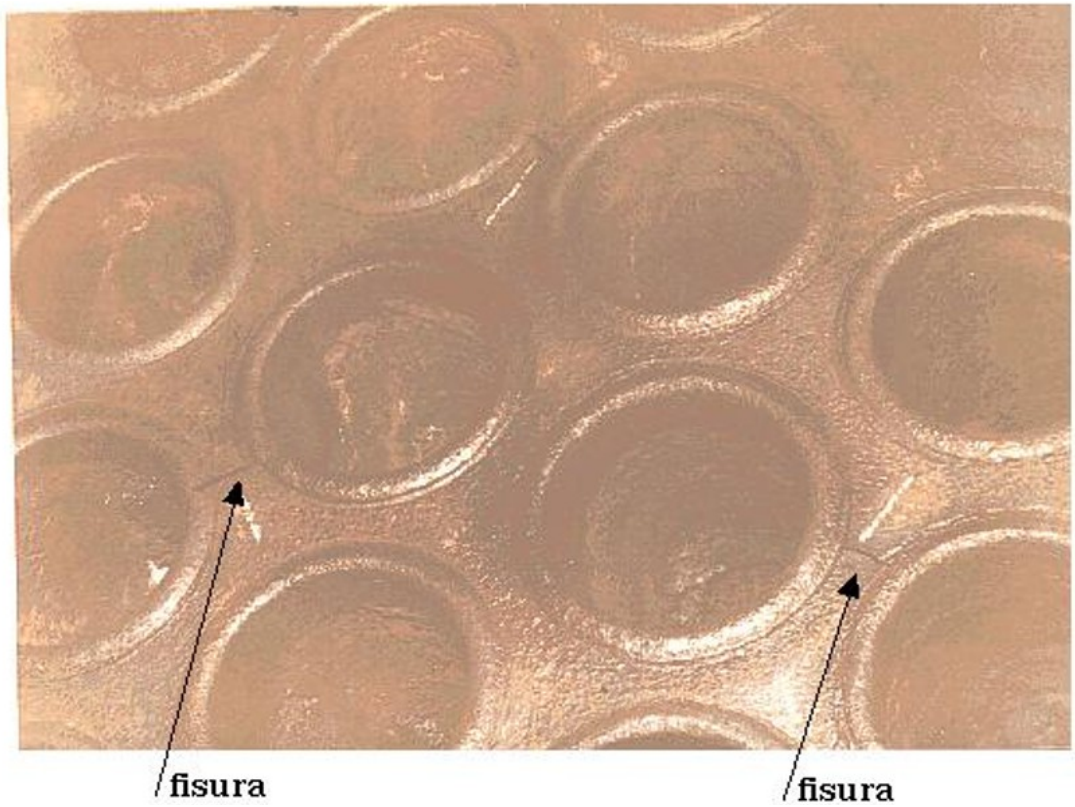
This method of using a torch for longitudinal cutting, based on cold logic, seems to show that the heat from the torch during cutting remains in the thinner sleeve (its temperature rises rapidly during the cut).

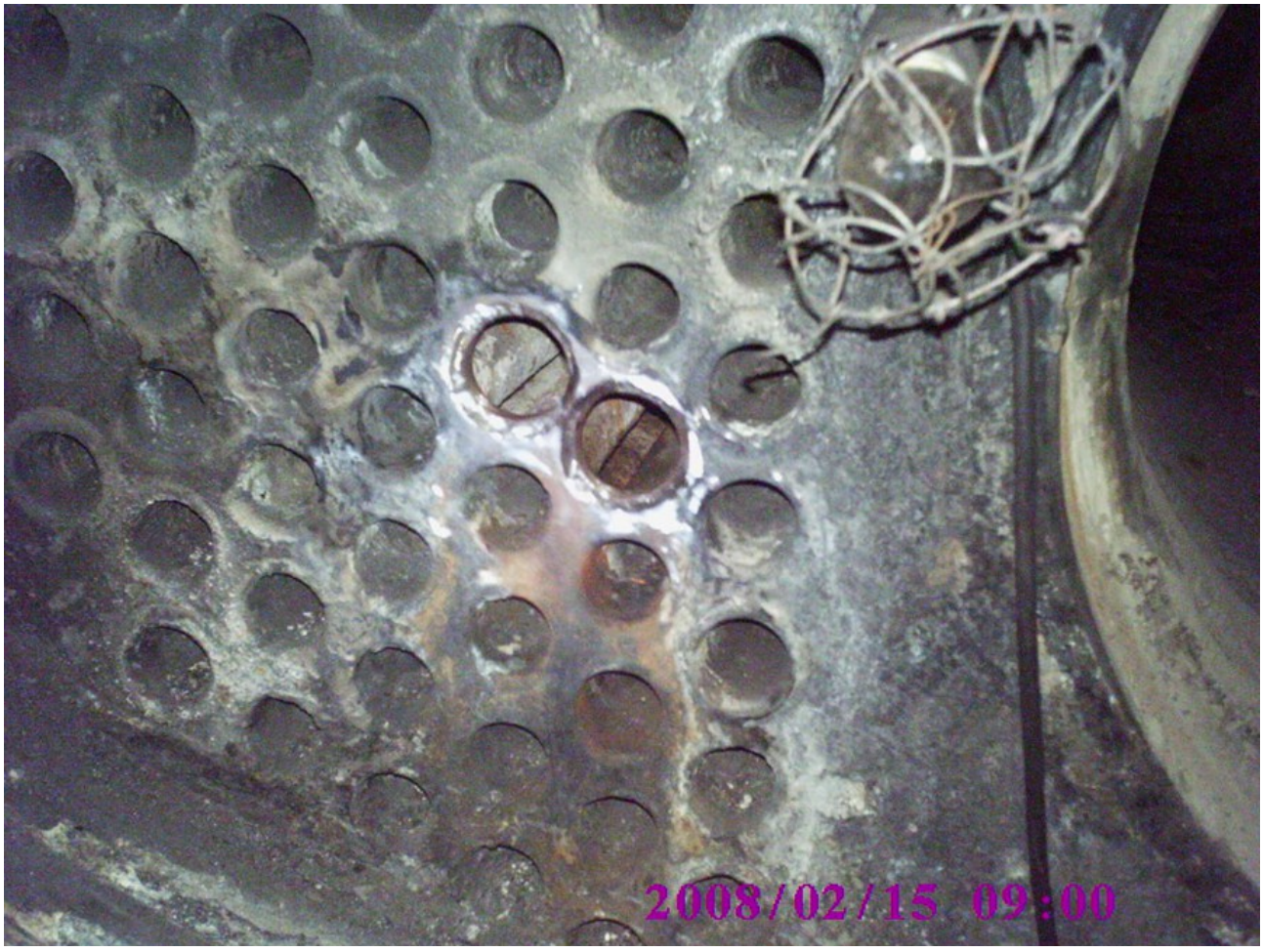
Since the much thicker plate remains cool (its heat dissipation is far greater than in the sleeve, therefore its temperature doesn't rise significantly).

Cutting with a gas cylinder flame temperature doesn't appear to damage the plate's seating surface (but be careful when using an oxyacetylene torch, where the cutting flame temperature is much higher, penetration into the sleeve can be excessive, potentially damaging the tubes' seating on the plate).

I've tried all the systems. I've seen plates damaged by improper torch cutting (when acetylene was used instead of propane and oxygen), but I've also racked my brains with longitudinal cutting chisels, as they aren't easy to manufacture and work with without breaking due to brittleness or denting due to lack of hardness.

Everyone will draw their own conclusions, but I recommend doing a preliminary test in the workshop, "practicing" before starting the work, with a piece of metal of similar thickness to the plate, with several mandrels (or mandrels and welds), and testing which method can be done safely.



Cracks in the plates of a tubular boiler can also occur due to other causes:

- Mechanical, thermal, and chemical effects.
- Scaling in the boiler.
- Boiler with excessive combustion.
- Very rapid starts.
- Internal foaming.
- Excessive pressure drops with the burner set to high.
- Use of fragile water.
- Excessive pH (very alkaline).
- Lack of purging.
- Excessive mandrel drilling. Very short combustion chambers.
- Boilers burning gas when they are not designed for it.
- Boilers with pronounced pressure variations.
- Boilers made with unsuitable metals.